GEOLOGY AND ORIGIN OF TACONITE CRATER ON THE VERA RUBIN RIDGE

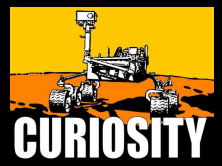
MCAM10734, MCAM10737
NASA/JPL-Caltech/MSSS/Jason Van Beek

F. J. Calef III[1] (@cirquelar), D. Wellington[2] , H. Newsom[3] , T. Gabriel[4]

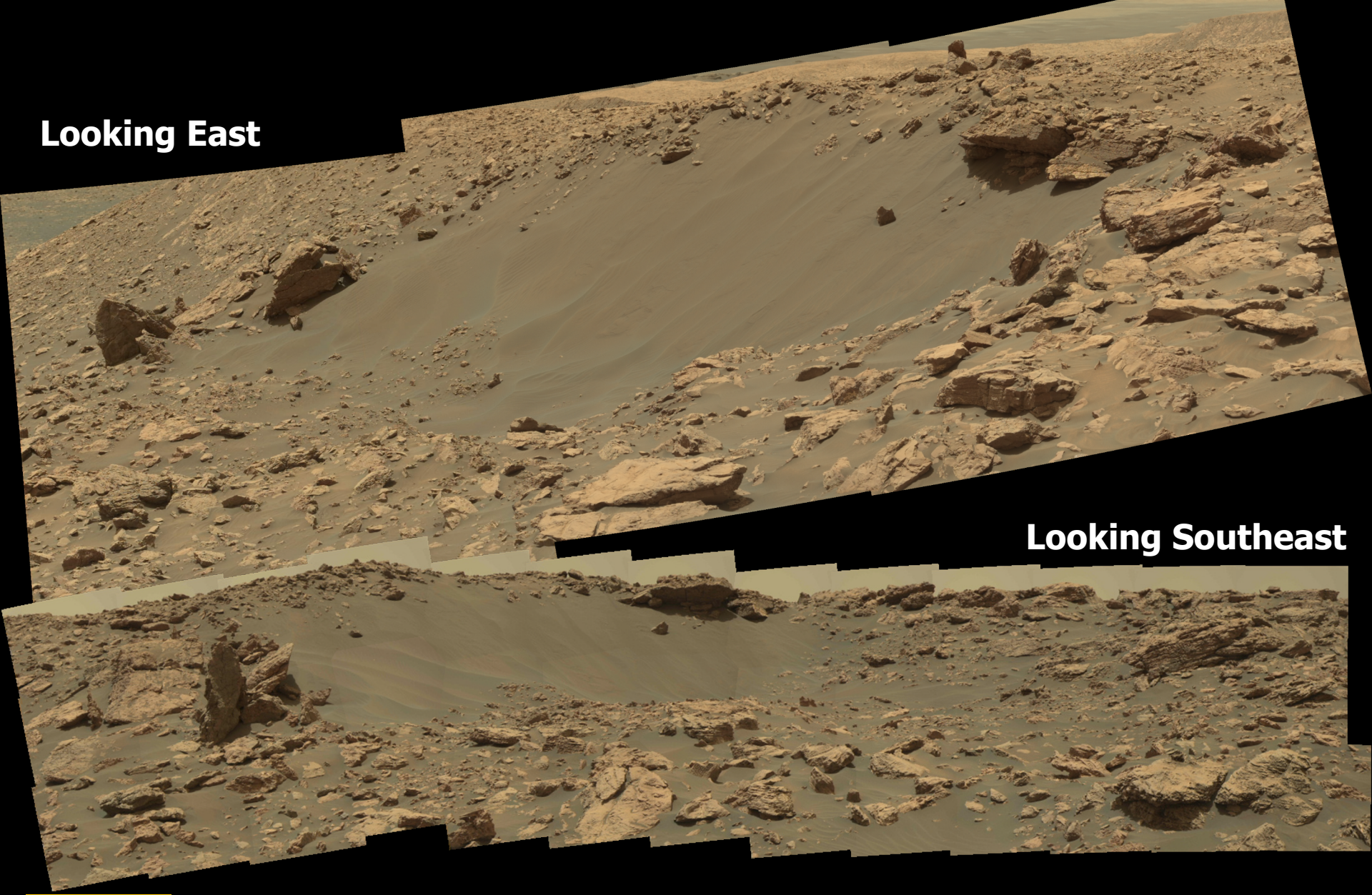
[1]Jet Propulsion Laboratory, California Institute of Technology, Fred.Calef@jpl.caltech.edu.
[2]School of Earth and Space Exploration, Arizona State University, dfwellin@asu.edu.
[3]University of New Mexico, newsom@unm.edu
[4]Arizona State University, tgabrie1@asu.edu

Permission to Tweet Away!

- Sub-kilometer diameter (‘small’) primary and secondary craters dominate the impact population on Mars and other planetary bodies [1].
- ‘Fresh’ craters, those whose fine and blocky ejecta components remains extant on the surface as rays visible from orbit, occur more often in the aforementioned size range, with a few notable exceptions [2].
- Most small fresh craters observations come from orbital measurements and morphologic studies using highresolution imagery and digital elevation models [3,4,5].
- Direct in situ observations of small fresh craters are recorded by the Mars Exploration Rover Opportunity, e.g. Concepción crater [6] and the InSight Lander, Corintito [7].
- This research documents the first small fresh crater investigated by the Curiosity rover in Gale Crater, Mars during its investigation along the Vera Rubin Ridge (VRR) (Figure 1).

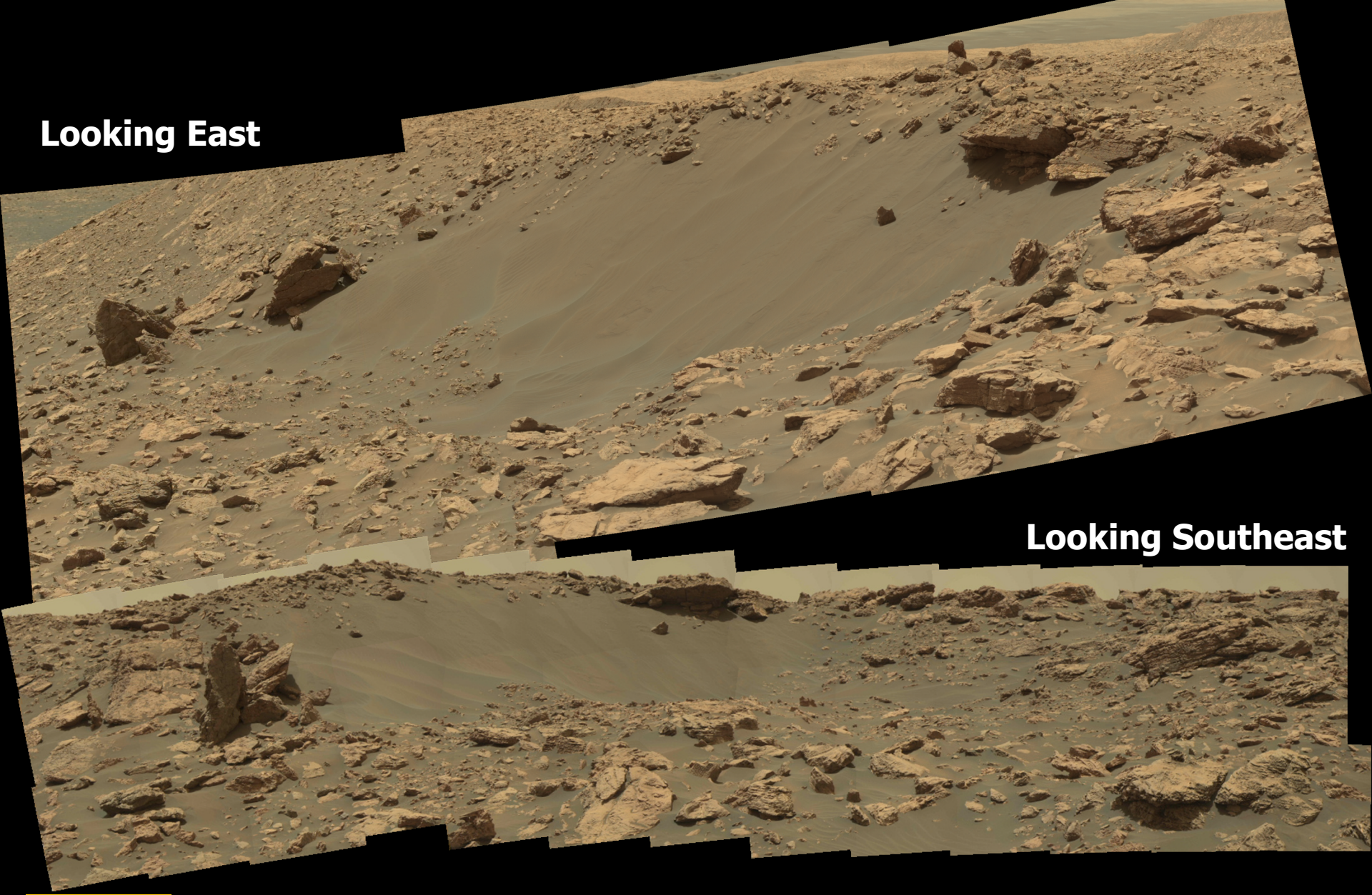


Introduction



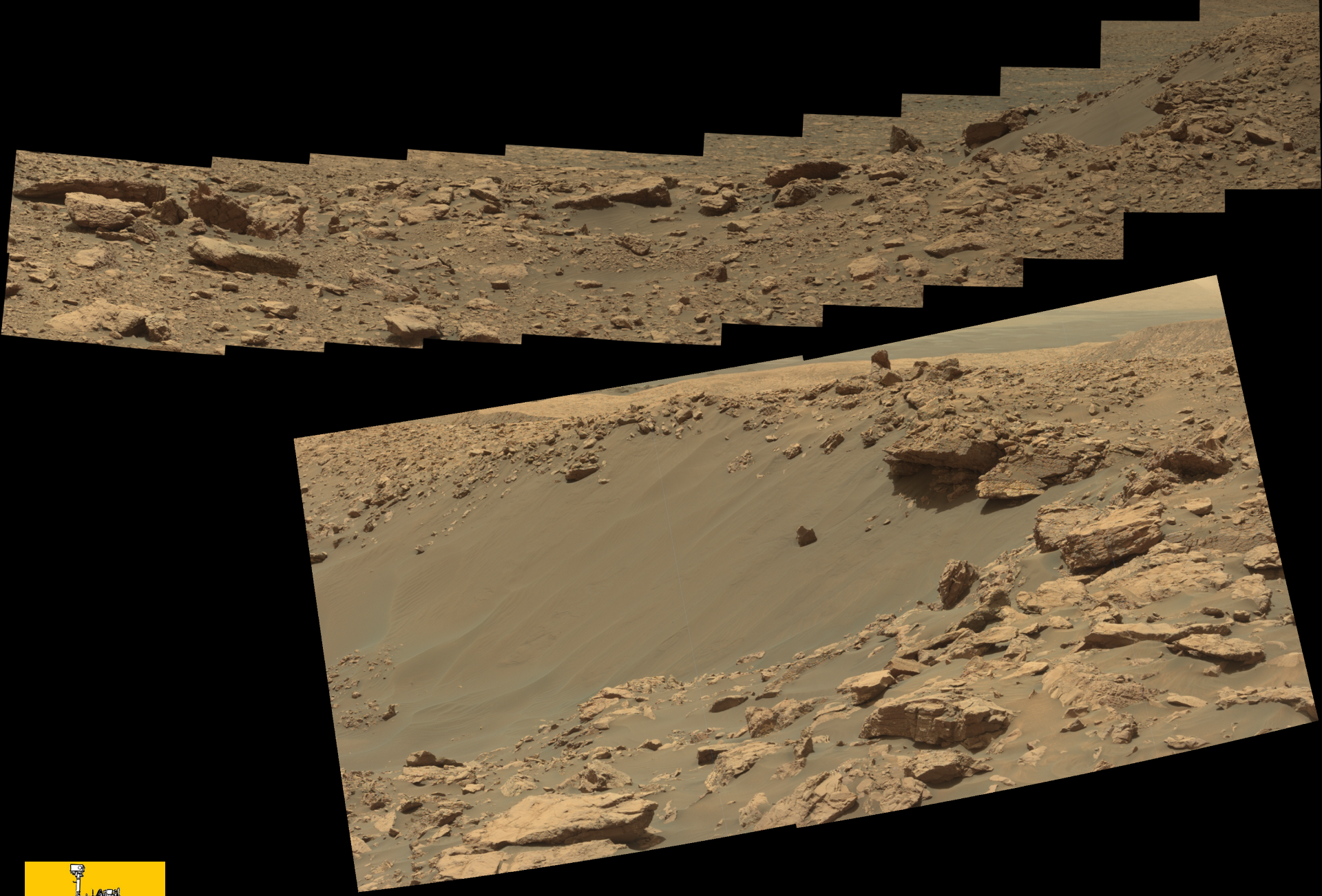
CURIOSITY

Taconite Crater: Two Views



CURIOSITY

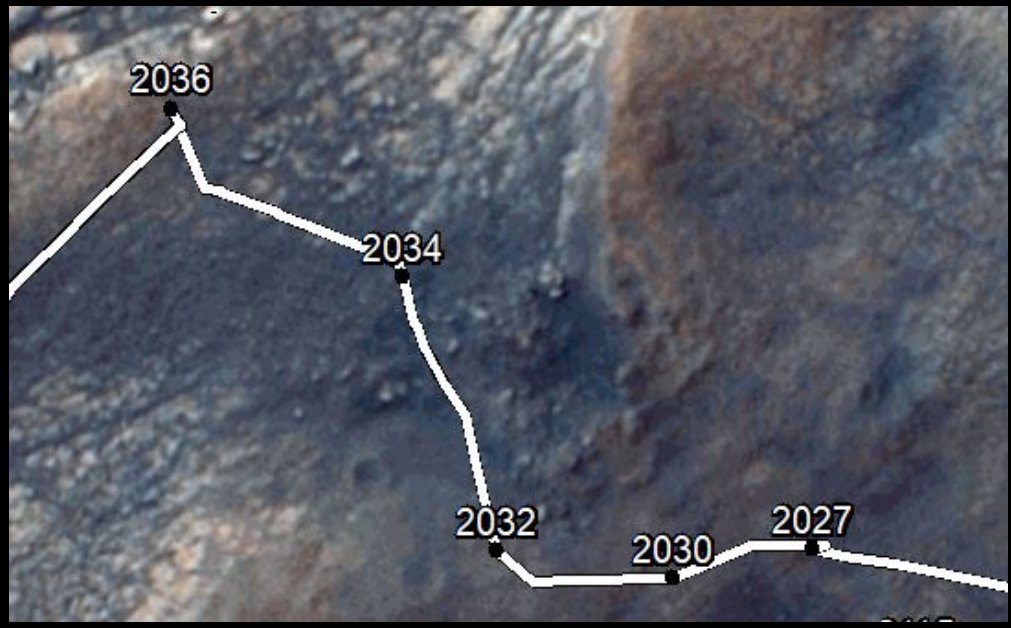
Taconite Crater: Two Views



CURIOSITY

Taconite Crater: North Rim Blocks

- impacted into the side of a ‘bench’ that separates lower and upper parts of the Vera Rubin Ridge.
- elliptical crater is 12 m by 9 m as measured in HiRISE
- largest diameter is oriented along an axis angle 15° west of north.
- lowest to highest part of the crater rim differs by ~2.5 m.
- Detrending orbital elevation data (1 m/pixel) yields ~0.3 m depth for a depth/Diameter (d/D) ratio of 0.028.
- Meter to decimeter scale blocks line the rim and more so to the west.
- finer component (sand-sized) ejecta can be seen extending to the northwest and within one crater radii to the north, west, and south.
- eastern edge of the rim appears ejecta free, perhaps due to the impact geometry



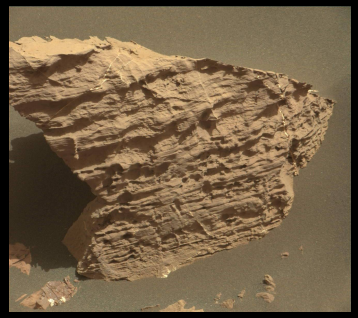
- The irregular crater shape, lack of a well defined rim, and shallow d/D ratio lend to the interpretation that this is a secondary crater.
- upper parts of the VRR resist Curiosity’s percussive drill, even at the highest percuss levels, yet retains small D craters.
- A low velocity (100’s m/sec), low angle impact is consistent.
- retention age is on order ~1-10 Mya or younger, if we compare it's morphology to similar young secondary impacts from craters like Zunil [1].

CURIOSITY

Physical Description

Logan

Mesabi



Eveleth

Kenora

Image Credit:
NASA/JPL-Caltech/MSSS

Midway

Hibbing

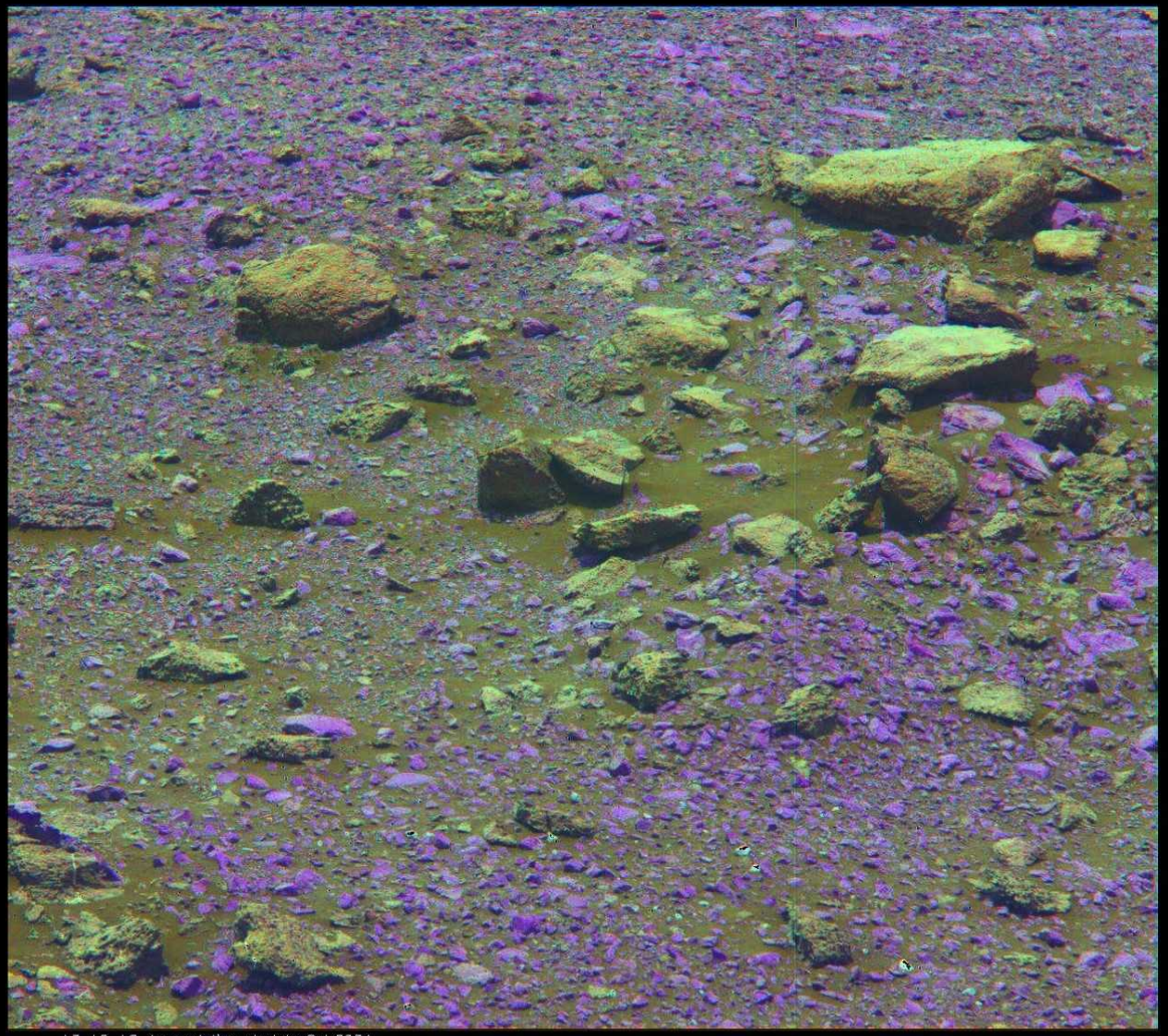
Ely

Taconite

CURIOSITY

Taconite Crater Ejecta Blocks

- MASTCAM 34 mm (M34 or L) and 100 mm (M100 or R) focal length.
- A decorrelation stretch using bands L3, L5, and L6 (751, 867, 1012 nm centered bandpass filters respectively)
- two distinct rock populations:
  1. hematite-like ferric ‘purple’ rocks consistent with the iron rich Vera Rubin Ridge
  2. a lower ferric component ‘green-yellow’ rocks excavated by the impact.



L3–L5–L6 decorrelation stretch: Sol 2034
Decorrelation stretch of bands L3 (751 nm), L5 (867 nm), and L6 (1012 nm) (R,G,B, respectively).
LMST: 11:55 LTST: 12:32 Site Frame Solar Azimuth: 322° Site Frame Solar Elevation: 77°
Calibration state: Cosine-corrected I/F, ASU RDR software version V2.1.0
Associated caltarget sequence: Sol 2034 mcam10736

CURIOSITY

Multispectral Observations of Ejecta

A ~5km diameter, single-layer ejecta, complex crater called Slangpos is ~33 km to the west, just inside the Gale crater rim. There is no obvious secondary crater rays from it, but Taconite is at a distance where a few distal secondaries could occur. A back-of-the-envelope calculation using Mars' gravity, a 45° ejection angle and initial velocity at ~350 m/sec can eject a block ~33 km away with an impact velocity of ~250 m/sec. Such a low speed impact would be consistent forming an irregular blocky crater, like Taconite. Though sparsely cratered and a very small area (~52 km2), a crater count on the Slangpos ejecta yields an age of ~100 Ma.

CURIOSITY

Taconite Crater Origin: Slangpos?

- Taconite crater appears to be a fresh small secondary impact, possibly from the nearby Slangpos single layer ejecta crater.
- The ejecta blocks and fine component are spectrally distinct from the VRR surface outcrop and may represent original impactor material.
- Low velocity secondaries may offer a unique opportunity to sample geologic materials from 10 to 100 (even 1000+) km away.
- Further investigation is warranted to compare the spectral properties of the ejecta with nearby outcrops as well as exploring the chance of impactor survivability.

Conclusions and Future Work